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A Study onthe Variations of Musculo-Cutaneous Nerve In Relation To Coracobrachialis & Median Nerve

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Abstract:*The musculocutaneous nerve is a branch coming from lateral cord of brachial plexus. After origin it enters the arm by piercing the coracobrachialis and supplies it along with other muscles of arm, then it continue into the forearm as lateral cutaneous of forearm. Variations in the branching pattern of nerve are not uncommon but have clinical significance during surgical procedures involving brachial plexus block and in diagnostic clinical neurophysiology.Methods:In the present study, 100 upper limbs of 50 cadavers preserved with formalin available in the department of anatomy were dissected and the formation, course, relations and branches of musculocutaneous nerve in the axilla, arm, forearm and hand were observed and compared with the previous studies of various authors.Results:In the present study, 8% of the specimens showed communicating branches with the musculocutaneous nerve &in 2% of the specimens the median nerve was innervating anterior compartment of the arm along with the absence of musculocutaneous nerve.*

Keywords*:musculocutaneous nerve, coracobrachialis, median nerve, variations.*

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I. Introduction

The musculocutaneous nerve(MCN) arises from the lateral cord(C5-C7), opposite the lower border of pectoral minor. It pierces coracobrachialis(CB) and descends laterally between biceps brachii(BB) and brachialis to the lateral side of arm. It pierces the deep fascia lateral to the tendon of biceps and continues as lateral cutaneous nerve of forearm(LCNF). It supplies coracobrachialis, biceps brachii & most of the brachialis. The branch to coracobrachialis is given before the musculocutaneous nerve enters the muscle, branches to biceps and brachialis leave, branches to biceps and brachialis leave after the nerve piereced coracobrachialis. The branch to brachialis also supplies elbow joint. The musculocutaneous nerve supplies as branch to humerus, which enters the shaft with the nutrient artery. An isolated lesion of musculocutaneous nerve is rare, but may occur in injuries to the upper arm and shoulder.[1]

II. Material & Methods

In the present study, 100 upper limbs of 50 cadavers preserved with formalin available in the departmentof anatomy were dissected and the formation, course, relations and branches of median nerve in the axilla, arm, forearm and hand were observed and compared with the previous studies of various authors.

III. Results

FIG 1:showed an abnormal thick communicating branch (Cn) between the musculocutaneous nerve and the median nerve (MN) proximal to piercing of coracobrachialis by the musculocutaneous nerve.

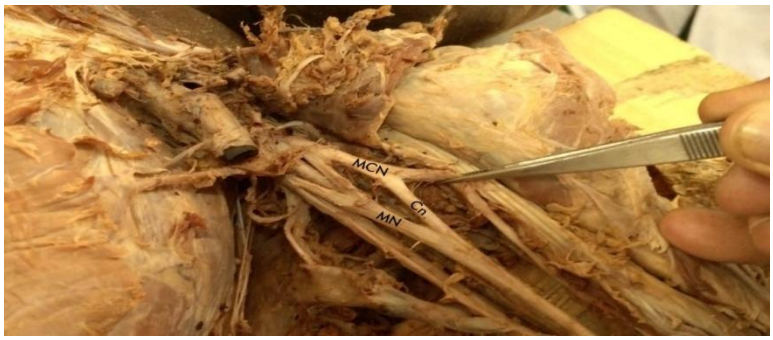

FIG 1: Communication between MCN & MN proximal to entry of MCN into CB.

FIG 2 & 3 showed bilateral variations in the branching pattern with abnormal communicating branch between musculocutaneous nerve and median nerve, and the musculocutaneous nerve not piercing the coracobrachialis

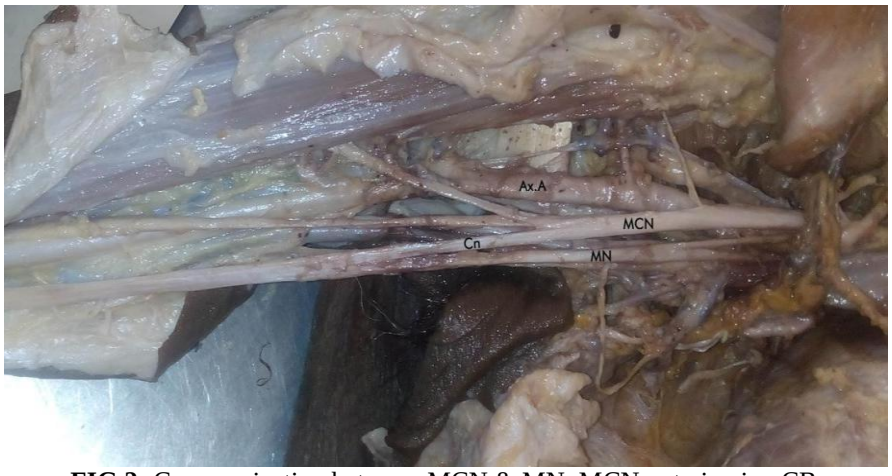

FIG 2: Communication between MCN & MN; MCN not piercing CB

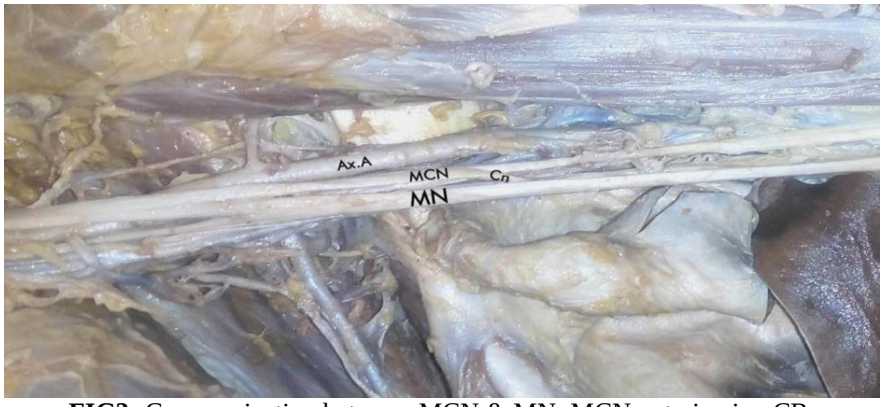

FIG3: Communication between MCN & MN; MCN not piercing CB

FIG 4: showed abnormal communicating branch between musculocutaneous nerve and median nerve,and the musculocutaneous nerve not piercing the coracobrachialis

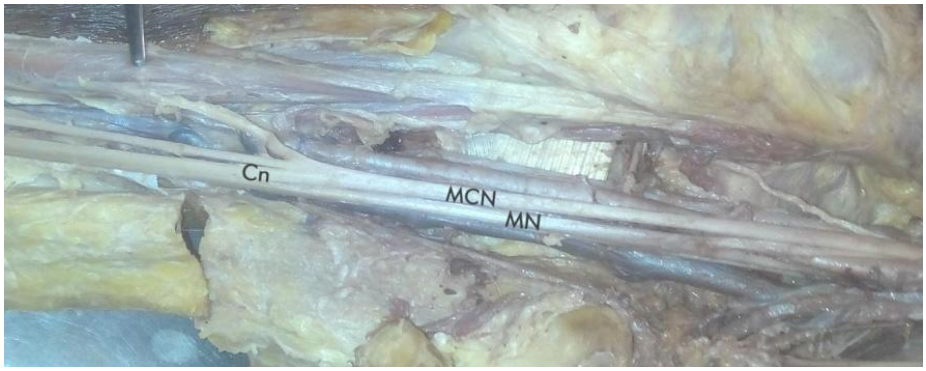

FIG 4: Communication between MCN & MN & MCN not piercing CB

FIG 5: showed abnormal communicating branch between musculocutaneous nerve and median nerve, distal to piercing of coracobrachialis by musculocutaneous nerve.

FIG 5: Communication between MCN & MN distal to exit of MCN from CB

FIG 6: showed abnormal communicating branch between the musculocutaneous nerve and the median nerve,and the musculocutaneous nerve not piercing the coracobrachialis.

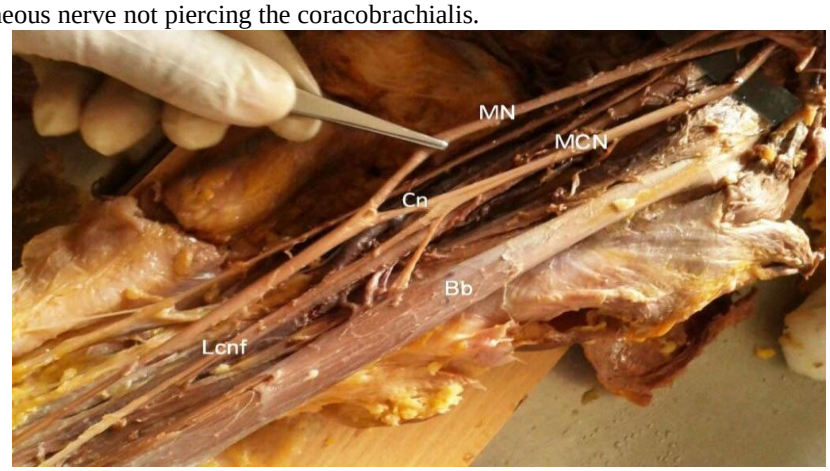

FIG 6: Communication between MCN & MN; MCN not piercing CB

FIG 7: showed abnormal branching pattern of the median nerve giving rise to branches for coracobrachialis, biceps brachii, brachialis and gave rise to lateral cutaneous nerve of forearm from the median nerve, and the musculocutaneous nerve is absent.

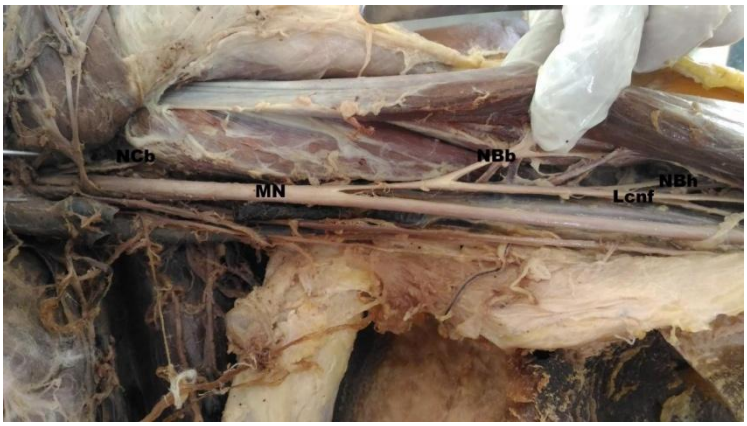

FIG 7: MN innervating anterior compartment of arm & giving rise to Lcnf ; MCN is absent.

FIG 8: showedabnormal branching pattern of the median nerve where the median nerve is giving branches to coracobrachialis, biceps brachii, brachialis and gave rise to lateral cutaneous nerve of forearm and themusculocutaneous nerve is absent.(Fig.no:20)

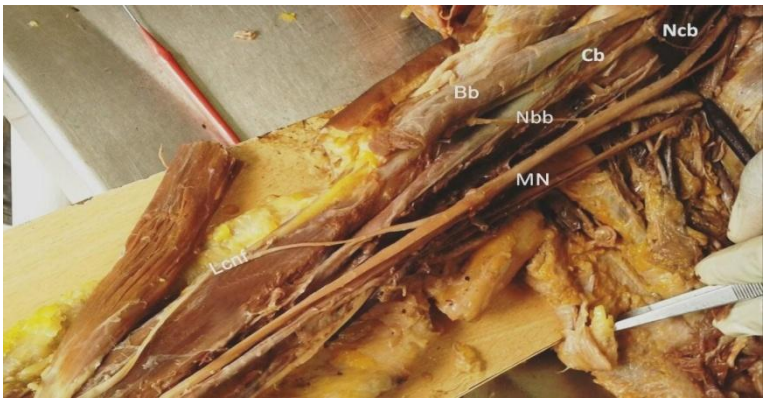

FIG 8: MN innervating anterior compartment of arm & giving rise to Lcnf ; MCN absent

1% of the specimens showed abnormal communicating branch between the musculocutaneous nerve and the median nerve in the axilla and the remaining 99% showed no such abnormal branches.5% of the specimens showed abnormal communicating branches between the musculocutaneous nerve and the median nerve in the arm. The remaining 95% of the specimens in the arm didn't have any communications.2% of the specimens showed abnormal branching pattern of the median nerve where the median nerve is giving branches to coracobrachialis, biceps brachii, brachialis and gave rise to lateral cutaneous nerve of forearm and themusculocutaneous nerve is absent.The remaining 98% of the specimens showed innervations of the muscles of the arm by the musculocutaneous nerve.

IV. Discussion

TABLE NO.1: Comparision of percentages of communications between MCN & MN

Sl.no	Author (year)	Incidence (%)
1.	Venieratos D et al (1998)	13.9%
2.	Choi et al (2002)	26.4%
3.	Chitra (2007)	26%
4	Bhudiraja(2011)	11.2%
5.	Malukar O (2011)	8%
6.	N Kumar (2013)	28%
7.	Channabasanagouda et al (2013)	12%
8.	Yoganandham Janani (2014)	23.4%
9.	Nandhini (2015)	13.3%
10.	Present study	8%

In the present study, 8% of the specimens showed communicating branches with the musculocutaneous nerve and these findings are similar to Malukar O et al [2], and closely similar to Bhudiraja V et al [3], Channabasanagouda et al [4], Nandhini [5], Venieratos D et al [6] while, Yoganandham Janani [7], N Kumar [8], Chitra [9], Choi et al [10] recorded the same in higher number of specimens.Types of communications between musculocutaneous nerve and median nerve have been classified by different authors.

Le Minor (1990) [11] categorised these communications into following five types:

Type 1:There are no communicating fibres between the musculocutaneous and the median nerves. The musculocutaneous nerve pierces the coracobrachialis muscle and innervates the coracobrachialis, biceps brachii and brachialis muscles.

Type 2: Although some fibres of the medial root of the median nerve unite with the lateral root of the median nerve to form the median nerve, some leave to run within the musculocutaneous nerve and after some distance leave it to join their proper trunk.

Type 3: The lateral root of the median nerve runs into the musculocutaneous nerve and, after some distance, leaves it to join its proper trunk.

Type 4: The fibres of the musculocutaneous nerve unite with the lateral root of the median nerve and, after some distance, emanate from the median nerve.

Type 5: Musculocutaneous nerve is absent and the entire fibres of the musculocutaneous nerve pass through the lateral root and fibres to the muscles supplied by musculocutaneous nerve branch out directly from the median nerve.

Classification by Venieratos and Anagnostopoulu (1998) [12]: According to their classification, there are three types;

Type 1: Communication proximal to the entry of musculocutaneous nerve into coracobrachialis muscle.

Type 2: Communication distal to the exit of musculocutaneous nerve from the coracobrachialis muscle.

Type 3: Musculocutaneous nerve did not pierce coracobrachialis directly or through its branches but ran alongside the muscle and exhibited a communication between it and the median nerve.
Beheiry [13] added Type 4 to the above classification. According to him, the communicating branch along with musculocutaneous nerve pierced the coracobrachialis muscle following which the communicating branch joined the median nerve.Loukas andAqueelah (2005) [14] addedanadditional type(IV)toVenieratosandAnagnostopoulou's classification. Inthistype,thefirstcommunicationisproximaltothepoint ofentryoftheMCNintotheCBmuscleandanadditional communicationtakesplacedistally.
Choi D et al (2002)[15]in their article titled "Patterns of connections between the musculocutaneous and median nerves in the axilla and arm. They classified these communications into three patterns:
Pattern 1 – fusion of MCN and MN,
Pattern 2 – one communicating branch between MCN and MN,
Pattern 2a –communicating branch formed by one root of MCN,
Pattern 2b – communicating branch formed by two roots of MCN,
Pattern 3 – two branches of communication between MCN and MN.
Guerri- Guttenberg and Ingolotti (2009) [16] reported a new type of classification depending on the site of communications between the musculocutaneous and median nerves. Their study revealed that 84.6% were proximal, 7.7% distal and 7.7% had two communications, one being proximal and the other distal.
Kaur N & Singla RK (2013) [17] have provided the most elaborated classification as under-
Type I- No communication.
Type II-Some fibres of lateral root of median nerve pass through musculocutaneous nerve and join the median nerve at different levels in the form of communicating ramus.
Group A- A communicating ramus leaves musculocutaneous nerve immediately after the later is formed so that it gives appearance of trifurcation of lateral cord into a musculocutaneous nerve and two lateral roots.
Group B- The communicating ramus leaves musculocutaneous nerve before it pierces coracobrachialis (All flexor muscles supplied by musculocutaneous nerve)
Group C- The communicating ramus leaves musculocutaneous nerve after it has pierced coracobrachialis. (All flexor muscles supplied bymusculocutaneous nerve before the origin of communicating ramus)
Type III- All fibres of lateral root of median nerve pass with musculocutaneous nerve. The median nerve is just continuation of medial root only. However the musculocutaneous nerve after supplying flexors of forearm gives lateral root of median nerve to join the same. In other words the lateral root arises distal to origin of muscular branches from musculocutaneous nerve.
Type IV- Whole of lateral cord continues as lateral root of median nerve ie. Musculocutaneous nerve joins lateral root of median nerve and after some distance musculocutaneous nerve arises from the median nerve.
Group A- Musculocutaneous nerve arises from median nerve proximal to muscular branches for flexors of arm which are thus supplied by musculocutaneous nerve.
Group B- Musculocutaneous nerve arises from median nerve after the former had supplied muscles of forearm.Then the musculocutaneous nerve continues only as lateral cutaneous nerve of forearm.
Type V- Complete fusion of musculocutaneous and median nerve at different levels.
Group A- Musculocutaneous nerve is altogether absent with all its fibres passing through lateral root of median nerve. All branches of musculocutaneous nerve come from median nerve.
Group B-Musculocutaneous nerve supplies coracobrachialis and then completely fuses with median nerve. Rest of its branches comes from median nerve.
Group C- Musculocutaneous nerve supplies all flexors of arm and then fuses with median nerve.The lateral cutaneous nerve of forearm comes from median nerve.
Type VI- The communicating ramus arises in lower one-third of arm after musculocutaneous nerve has supplied all flexors of arm.It crosses the elbow joint and reaches forearm where it joins median nerve.
Group A- The communicating ramus joins median nerve without piercing pronator teres.
Group B- The communicating ramus joins median nerve after piercing pronator teres.

Watanabe.M et al (1985) [18] found 1.4% of cases fusion of the median and musculocutaneous nerves among 140 upper limbs. Basar et al (2000) [19] reported a case of a communicating branch between the median and the musculocutaneous nerves in a 42-year-old male cadaver. Uzun A and Seelig Jr. (2001) [20] reported a communicating branch that originated 1.6 cm distal to the origin of the musculocutaneous nerve and before it pierced the coracobrachialis muscle. It then joined the median nerve at the meeting of its two roots 20 cm above the intercondylar line of the humerus. Sarikcioglu et al (2001) [21] reported the presence of a communicating branch between the median and the musculocutaneous nerves.Chauhan and Roy (2002) [22] reported an additional third branch coming from the musculocutaneous nerve which also gave a communicating branch to the median nerve. Shukla et.al (2010) [23] observed four communications present between the musculocutaneous and median nerves.C Ibrahim (2004) [24] reported a case of an unusual unilateral variation

between the median and musculocutaneous nerves that was found during the dissection of the arm of a 48 years old male cadaver and the abnormal communicating branch was significantly thick. This is a result of median nerve fibers from the lateral cord passing into the musculocutaneous rather than into the lateral root of the median and then rejoining the median nerve at a lower level. When this occurs, the lateral root of the median nerve is typically abnormally small.

TABLE NO.2: MN innervating anterior compartment of arm and absence of MCN

Author (Year)	INCIDENCE (%)
Eman Elazab Beheiry (2004)	1.7%
Jamuna M (2011)	6%
Guttenberg and Ingolotti (2009)	3.6%
Channabasanagouda et al (2013)	12%
Dr.Shashank M.J (2014)	5%
Present study	2%

In the present study, in 2% of the specimens the median nerve was innervating anterior compartment of the arm along with the absence of musculocutaneous nerve and this is closely similar to the findings made by Eman Elazab Beheiry [13] and Guttenberg and Ingolotti [16] while, more no. of specimens are observed by Dr.Shashank M.J [25], Jamuna M [26] and Channabasanagouda et al [4].Dr.Naimish R.Bhojak (2014) [27]in their study 4% cases there is absence of musculocutaneous nerve. Musculocutaneous nerve not piercing coracobrachialis and communicate with median nerve in 4% cases and musculocutaneous nerve rejoins with median nerve in 2% cases.Le Minor (1990) [11] reported absence of musculocutaneous nerve where in lateral cord of brachial plexus gave muscular branches to coracobrachialis and biceps brachii.According to his classification this finding belongs to type 5 communications where musculocutaneous nerve is absent and the entire fibres of the musculocutaneous nerve pass through the lateral root and fibres to the muscles supplied by musculocutaneous nerve branch out directly from the median nerve.Gumusburun and Adiguzel (2000) [28] reported bilateral absence of the musculocutaneous nerve in a 72 year old female cadaver where the median nerve supplied the biceps brachii and brachialis muscles and also gave off the lateral cutaneous nerve of the forearm. The coracobrachialis muscle was supplied by branches from the lateral cord of the brachial plexus.Sud and Sharma (2000) [29] reported a case of absence of the musculocutaneous nerve with innervations of the coracobrachialis and biceps brachii via the median nerve. The lateral cutaneous nerve of the forearm originated from the median nerve and gave off a muscular branch to the brachialis muscle.Jahanshahi M (2003) [30] described absence of Musculocutaneousnerve and muscles normally supplied by it were supplied by Median nerve, however the Median nerve was formed in normal way.Jamuna Meenakshisundaram (2012) [31] reported a single common cord with absence of musculocutaneous nerve on the left side of a cadaver was observed. The median nerve took over the innervations which are supposed to be supplied by the Musculocutaneous nerve.

V. Summary &Conclusions

In the present study, 100 formalin fixed upper limbs of 50 adult cadavers were dissected and observed for the anatomy, course, branches and distributing pattern of the median nerve from its formation to termination. Among the branches, 1% of the specimens showed abnormal communicating branch between the musculocutaneous nerve and the median nerve in the axilla and 5% of the specimens showed abnormal communicating branches between the musculocutaneous nerve and the median nerve in the arm.In 2% of the specimens, abnormal branching pattern of the median nerve is observed, where the median nerve gave branches to coracobrachialis, biceps brachii, brachialis muscles and gave rise to lateral cutaneous nerve of forearm and the musculocutaneous nerve is absent.Over all incidence of abnormal branching pattern of the musculocutaneous nerve was found to be 8%.The observations show that the musculocutaneous nerve has significant varaiations and that the variations have clinical significance in post tramatic evaluations and in exploratory interventions of arm for peripheral nerve repair. During shoulder surgery, it is important to identify or palpate the musculocutaneous nerve, as it is vulnerable to injury from retractors which are placed under coracoid process.[32] During the coracoids process grafting, shoulder dislocations and frequent arthroscopies may damage the muscles as well as nerve.[33] Though rare, the musculocutaneous nerve is prone to injury in its upper course, as it lies on the subscapularis muscle, its entry point into the coracobrachialis muscle is variable, and also because the nerve occasionally bifurcates.[34]The variations in the formation and relations of median nerve in the arm be a remarkable clinical significance. Clinicians & surgeons should be aware of such variations while performing surgical procedure in this region.

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